ORIGINAL
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TECHNICAL AND
COMMISSIONNING MANUAL
R E C 7 0
COS ATOMATIC SYNCHRONISER

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TECHNICAL MANUAL

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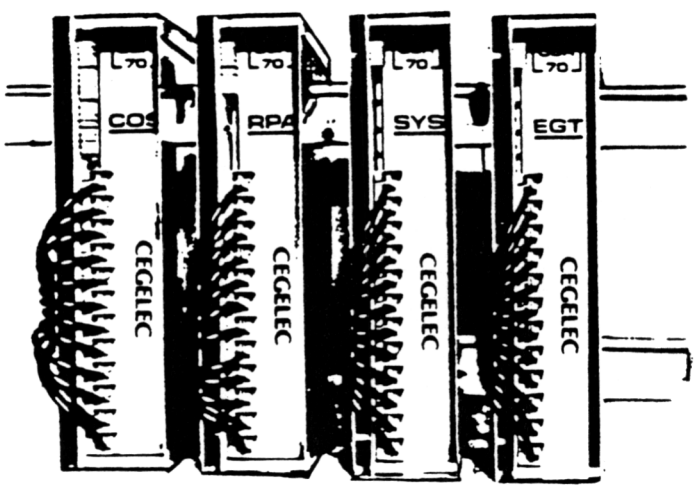

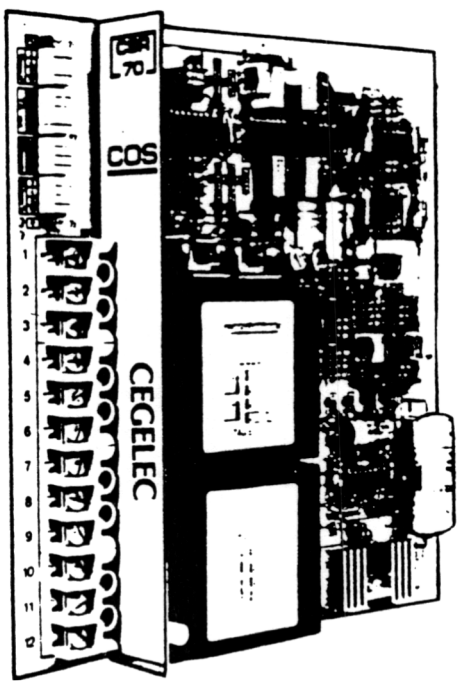

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OBJECT

The COS coupling unit is designed to enable or to transmit a closing order to a circuit-breaker separating two sources or between main supply and user networks when the conditions specified by the user are fulfilled.

Two operating modes are possible as indicated below :

A - Synchronization monitoring

A contact is closed when the following three conditions are fulfilled :

frequency deviation $\triangle F < \triangle F$ max Maximum frequency deviation

voltage deviation $\triangle U < \triangle U$ max Maximum voltage deviation

dephasing $\varphi < \varphi$ max Maximum phase-displacement

Examples of use :

Validation of manual coupling of an alternator

. Validation of circuit-breaker operations in industrial networks where several power sources exist.

Rapid transfer systems

B - Synchronization

When operating in this mode, a contact closes with a lead time TA, equivalent to the closure time of the circuit-breaker, before the inphase period. The coupling operation is done perfectly inphase.

Examples of use

Automatic synchronizing of a low power alternator

. Synchronizer SCS1, CS1, SCUS1 and UCS1 are more suitable for use with medium and high power alternators.

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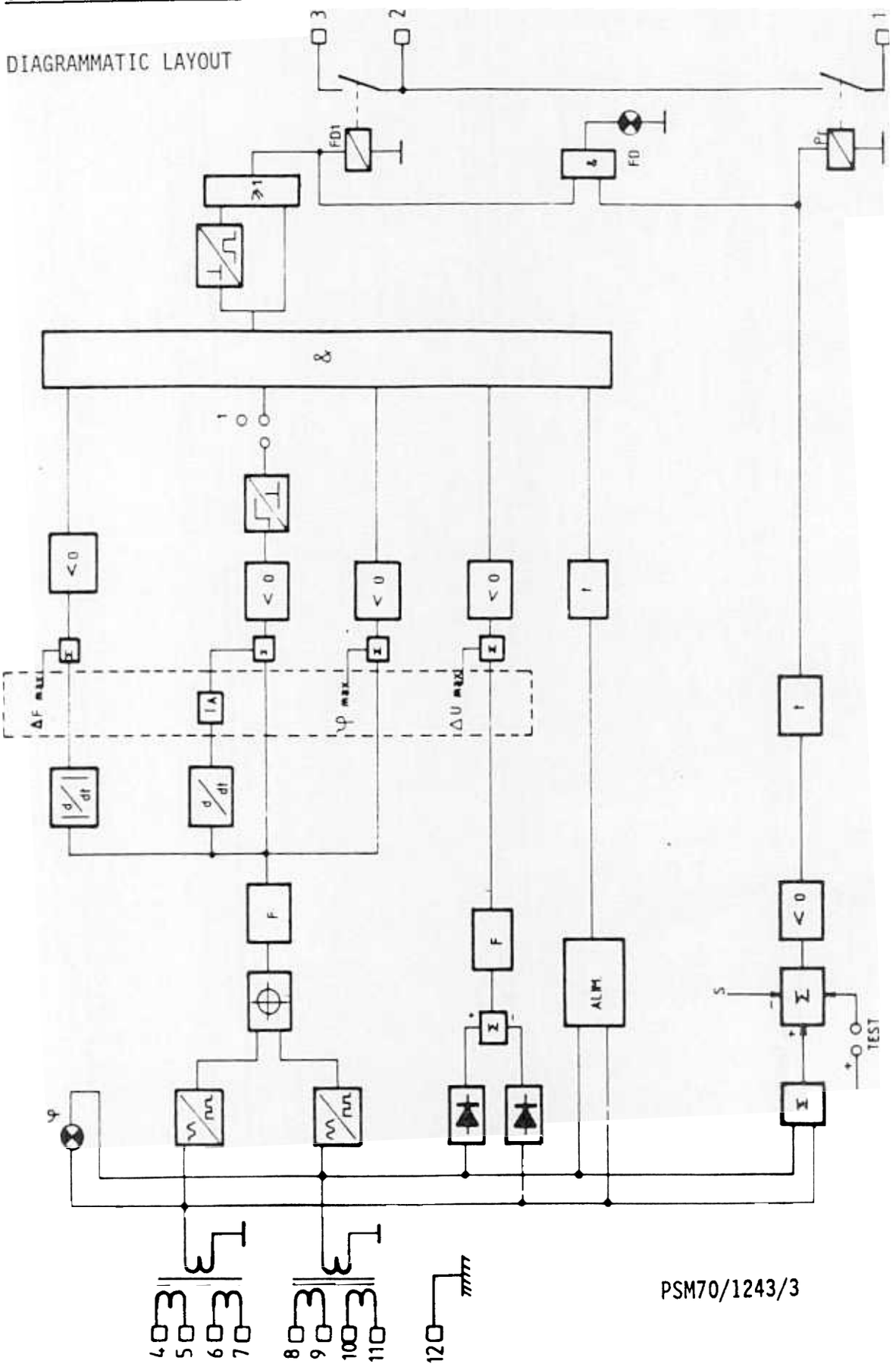
2 OPERATING PRINCIPLES

2.1 DIAGRAMMATIC LAYOUT



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2.2 ANALYSIS OF DIAGRAM

- Power supply sources

The two AC input voltages provide a direct current supply through two transformers and two floating rectifiers.

A voltage regulator supplies the stabilized power required (- 6V + 9 V + 15 V) for the various circuits.

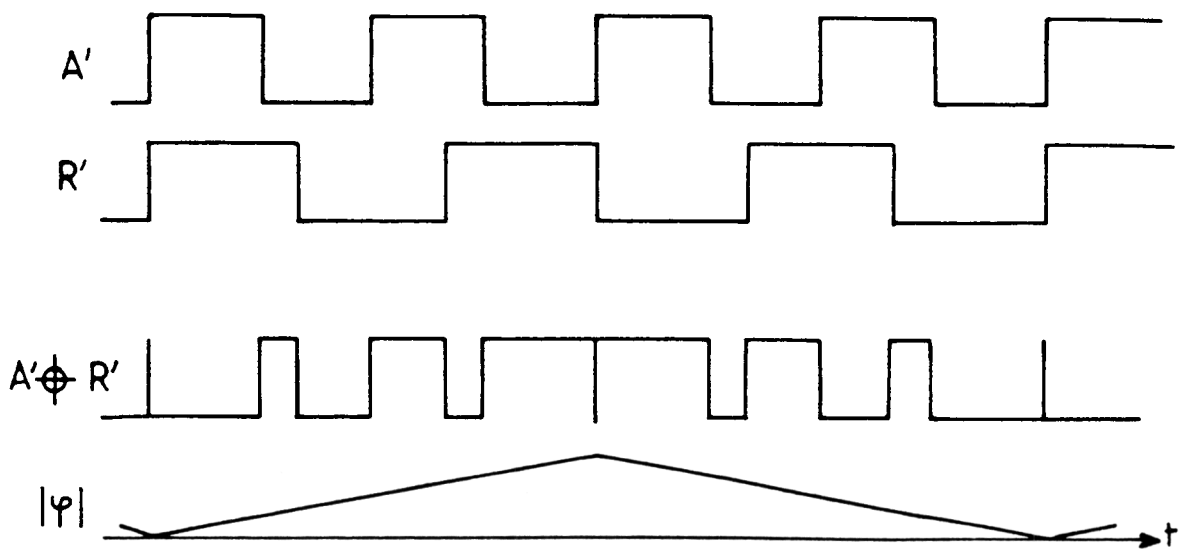
2 - Measurements

Voltage deviation $|\Delta U|$

The two power transformers also supply the 2 voltage measurements which are rectified, filtered and compared. The comparison is therefore made between mean values which are proportional to RMS values if the voltages are sinusoïdal : a second rectifier gives the absolute $|\Delta U|$ after comparison.

Phase displacement φ

The 2 voltages taken on the same transformers as above are adjusted to give square signals A′ and R′. A′ and R′ are applied to an "exclusive OR" followed by a 4 th. sequence filter giving $|\varphi|$.



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Frequency deviation

Frequency deviation is calculated by taking the derivative of the phase displacement

$$\triangle F = k \frac{d\varphi}{dt}$$

A rectifier circuit elaborates its absolute value $|\triangle F$

3 - Thresholds

The three measurements $|\triangle U|$, $|\varphi|$, $|\triangle F|$, are compared to 3 thresholds $\triangle U$ max, φ max, $\triangle F$ max, respectively and give the following logic information :

$|\triangle U| < \triangle U$ max

$|\varphi| < \varphi$ max

$|\triangle F| < \triangle F$ max

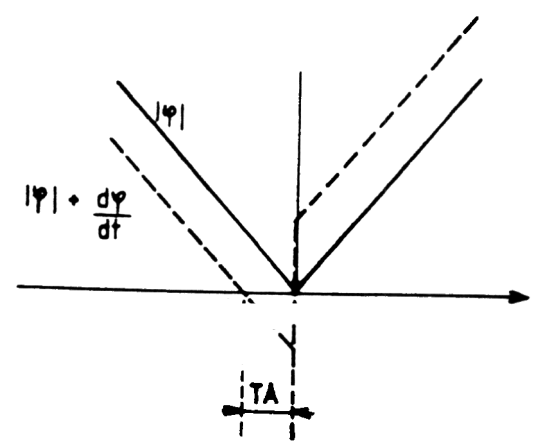
4 - Advance time TA

To elaborate a logic information for advance time TA before the inphase period, proceed as follows

(1) $|\varphi| + \lambda \frac{d\varphi}{dt} = 0$

As the frequency deviation can be considered constant in the relevant time interval, we may write :

$\varphi = -kt$; $\frac{d\varphi}{dt} = -k$



At point A : $-kTA - \lambda K = 0$ $\quad TA = -\lambda$

We can see that whatever the frequency deviation may be (k), the advance time TA which is provided by the equation (1) is constant. Adjustment of the constant λ of deviation controls the advance time TA.

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5 - Sequential

A logic "AND" gives the final information for either a "synchronisation monitoring" or a "coupling operation".

A monostable prolongs the duration of the output instruction since the information T = TA would be too short for recording by the electro-magnetic relays.

6 - Protection

As the "COS" coupler is of single chain type, a single protection circuit will avoid couplings for an excessively high phase deviation, or voltage or frequency difference in the event of failure of components of the main chain.

The 2 sinusoïdal voltages are compared, rectified and filtered.

The signal obtained is

$$D = A \sin\omega_A t - R \sin\omega_R t$$

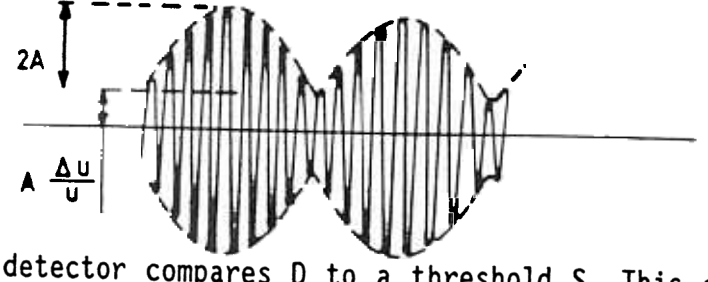
By writing : $\frac{\Delta u}{u} = \frac{A - R}{A}$ $\qquad R = A \left(1 - \frac{\Delta u}{u}\right)$

The equation becomes :

$$D = A (\sin\omega_A t - \sin\omega_R t) + A \frac{\Delta u}{u} \sin\omega t$$

$$D = A \left[2 . \operatorname{Cos} \frac{\omega A + \omega R}{2} t \times \frac{\sin\omega A - \omega R}{2} t + \frac{\Delta u}{u} \sin\omega_R t\right]$$

$$D = A \left(2 \operatorname{Cos}\omega t \operatorname{Sin} \frac{\varphi}{} + \frac{\Delta u}{u} \operatorname{Sin}\omega t\right)$$



A detector compares D to a threshold S. This detector is followed by a time delay of 30 ms in order not to take into account the $\cos\omega t$ or $\sin\omega t$ which reverts to zero every 10 ms, but only $\sin \frac{\varphi}{2}$ and $\frac{\Delta u}{u}$.

The protection functions for :

$\varphi < 40°$ $\qquad$ (for $\frac{\Delta u}{u} = 0$)

and $\Delta u < 50\ \%$ $\qquad$ for $\varphi = 0$)

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3 FUNCTIONAL CHARACTERISTICS

. Input voltages :

A	(4) (5)	110 V	)	110 V or 220 V at ± 20%
	(6) (7)	110 V		6 VA, 48/62 Hz
B	(8) (9)	110 V	)	110 V or 220 V at ± 20 %
	(10) (11)	110 V	)	6 VA, 48/62 Hz

Output relays :

(2 (3	F.D)	)	220 V	2 A 150 VA
(2 (1	P.R)	)	127 V	1 A 50 W

(Fit surge arresters at terminals of commanded relays or breaker)

Dielectric rigidity : Between A/ R/ Output contacts/ Earth
2 000 V 50 Hz 1 mn / 100 MΩ at 500 V DC
CEI 255-5.ANSI IEEE C 37-90-1978

Climatic conditions : Operation : - 5° C + 50° C
Storage : - 25° C + 70° C

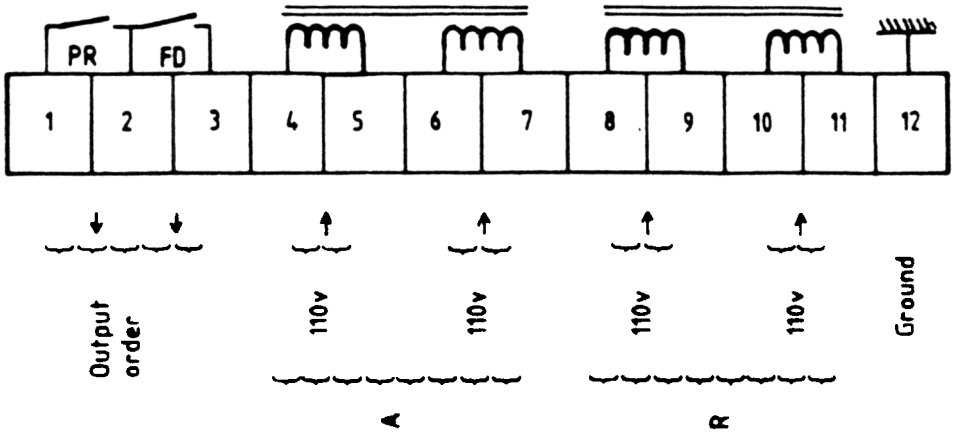
Adjustment range :

△ F max	0,1	to 0,75 Hz
△ u max	2	to 30 %
φ max	2	to 30°
TA	20	to 300 ms

Precision :

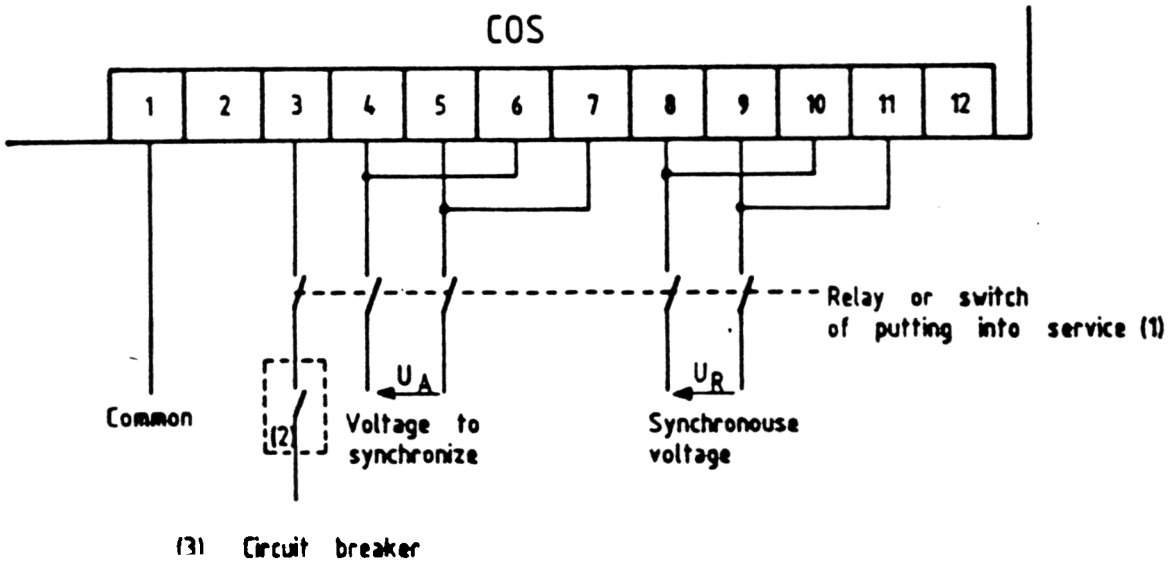
△ F < △ F max	± (0,05 Hz + 10 % △ F max)
△ u < u max	± (2 % + 10 % △ U max)
φ < φ max	± (2° + 10 % max)
T_A	± (20 ms + 10 % TA)

4 WIRING



USE WITH 100 V - 110 V OR 115 V VOLTAGE TRANSFORMERS

Utilisation range 88 V to 132 V



(1) Circuit breaker

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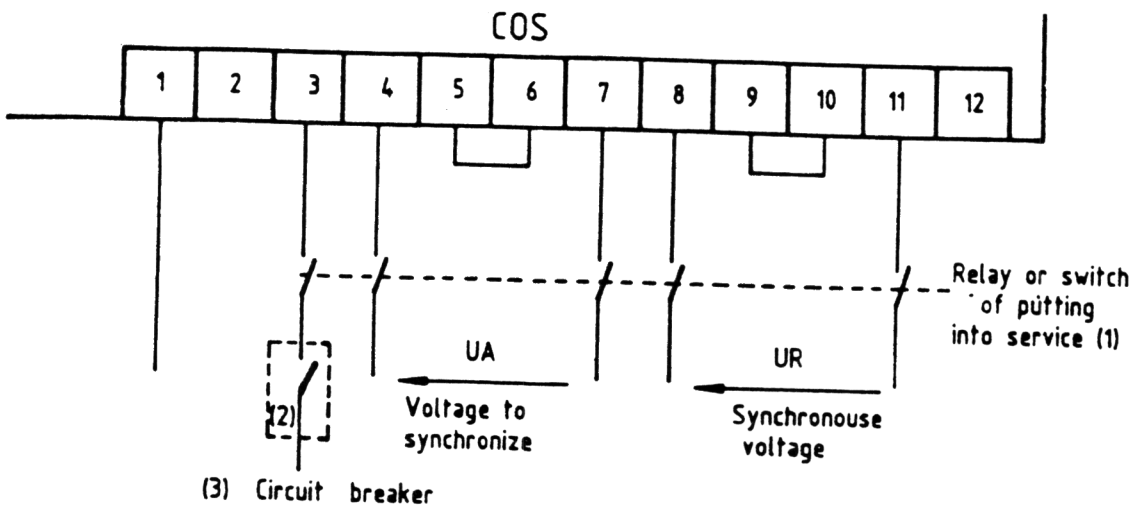
USE WITH 200 V OR 220 V VOLTAGE TRANSFORMER

Utilisation range from 176 V to 264 V :



Note 1 : The relay or switch (not supplied) must be installed when it is not necessary to leave the COS permanently connected (alternator coupling). It can act as a switch or branching relay when the unit is controlling several circuit-breakers.

The COS can f necessary remain permanently connected.

Note 2 : The contact is the actual control of the circuit-breaker switch only when this switch is being validated by the COS when the latter is being used to monitor synchronisation.

Note 3 : If the circuit-breaker switch coil is too powerful, use an intermediate relay as necessary.

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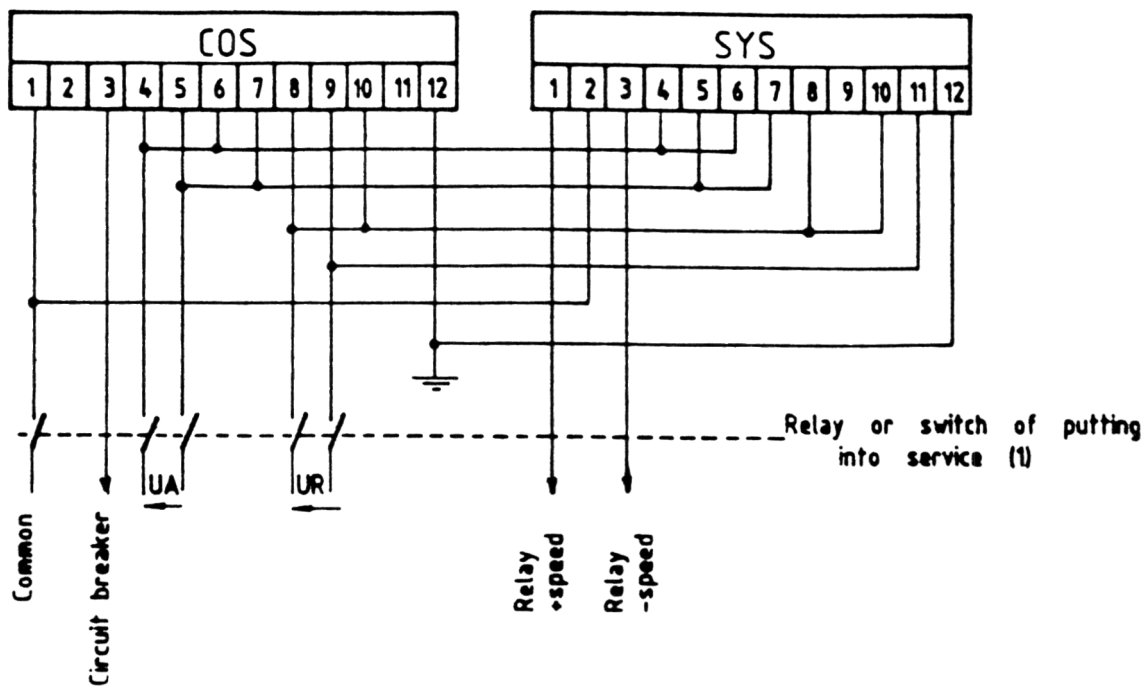
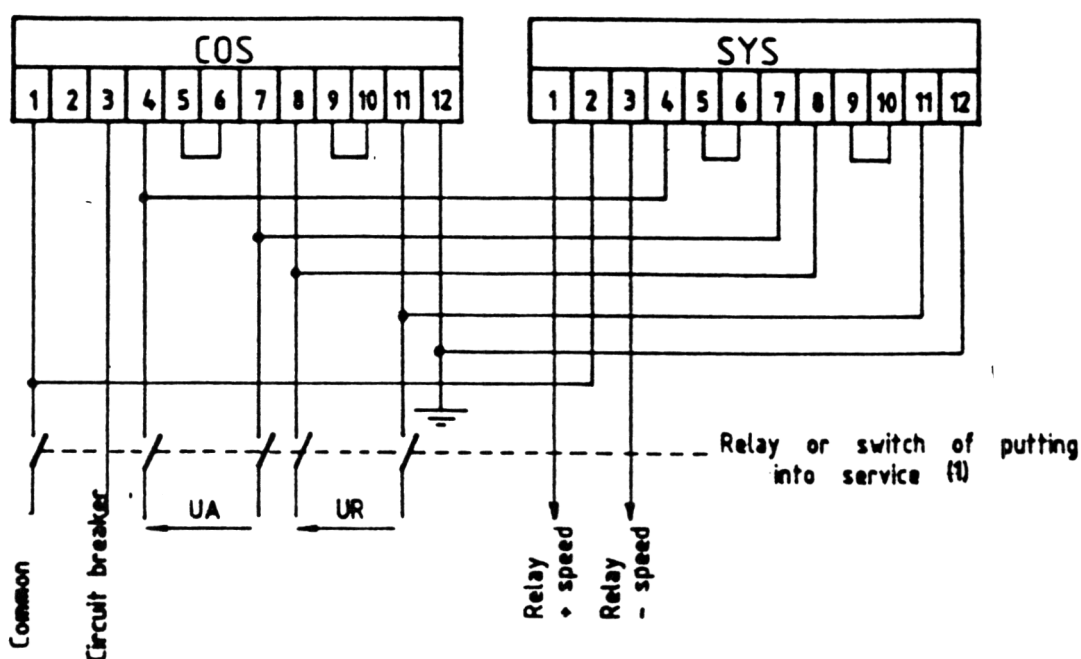
WIRING SHEME FOR A SYNCHRONIZING UNIT WITHOUT VOLTAGE EQUALISATION

Utilisation voltage 88 V to 132 V (VT : 100 V, 110 V or 115 V)



WIRING OF A SYNCHRONIZING UNIT WITHOUT EQUALISATION OF VOLTAGE

Utilisation voltage from 176 V to 264 V (VT 200 V, 220 V)


COS
1 2 3 4 5 6 7 8 9 10 11 12
SYS
1 2 3 4 5 6 7 8 9 10 11 12
Relay or switch of putting into service (1)
UA
UR
Common
Circuit breaker
Relay + speed
Relay - speed

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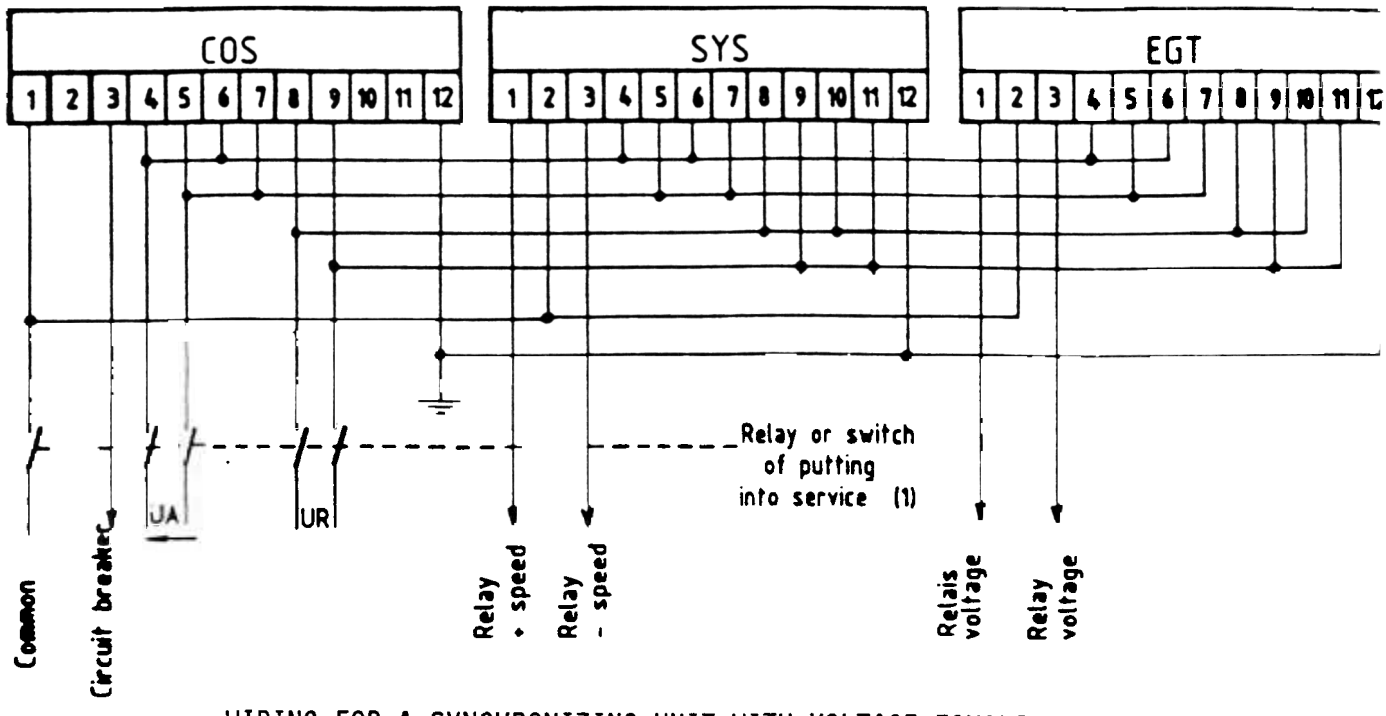
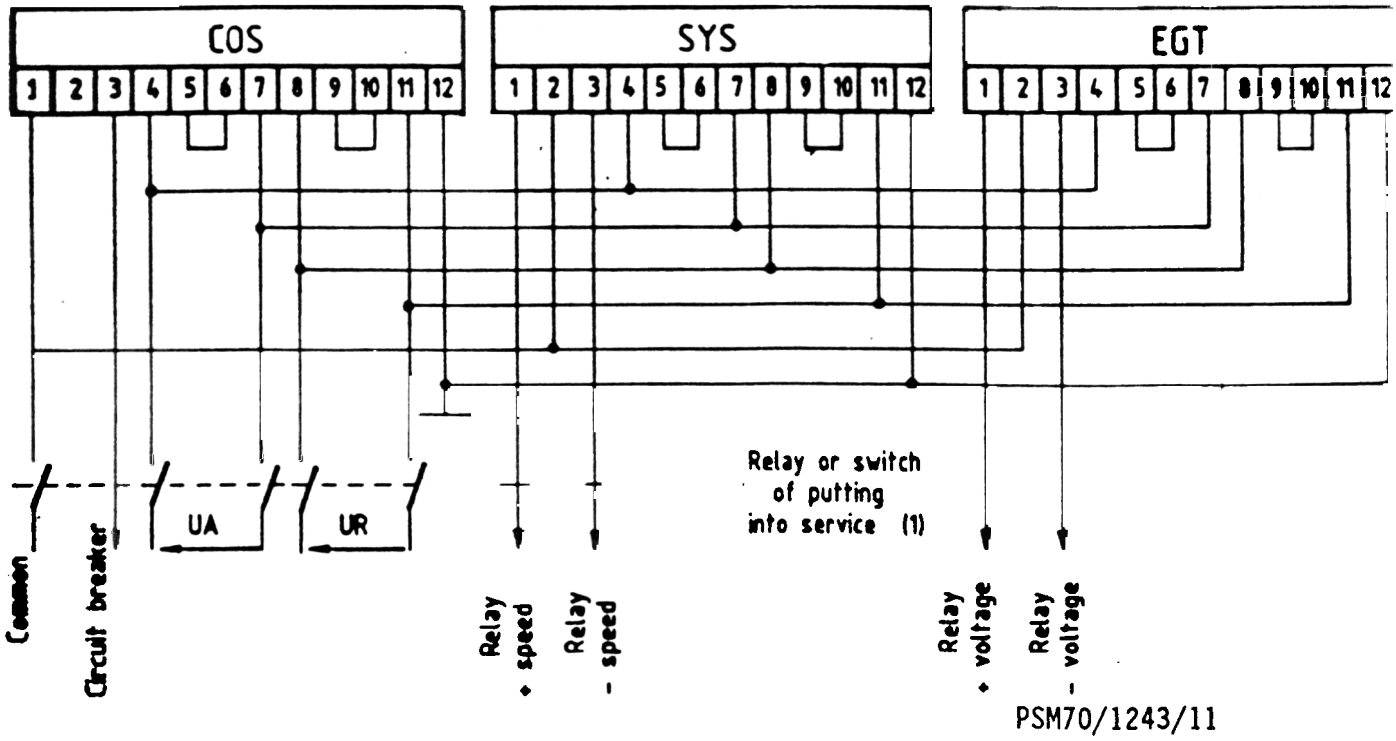
WIRING OF A SYNCHRONIZING UNIT WITH VOLTAGE EQUALISATION

Utilisation voltage 88 V to 132 V (VT 100 V, 110 V or 115 V)



WIRING FOR A SYNCHRONIZING UNIT WITH VOLTAGE EQUALISATION

Utilisation voltage 176 V to 264 V (VT 200 V, 220 V)



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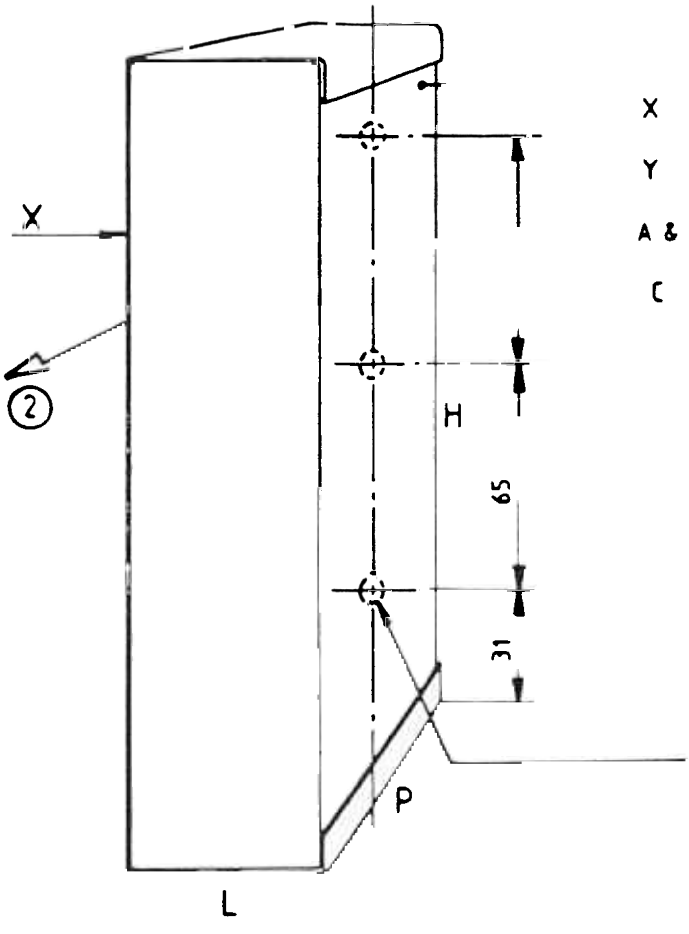
DIMENSIONS

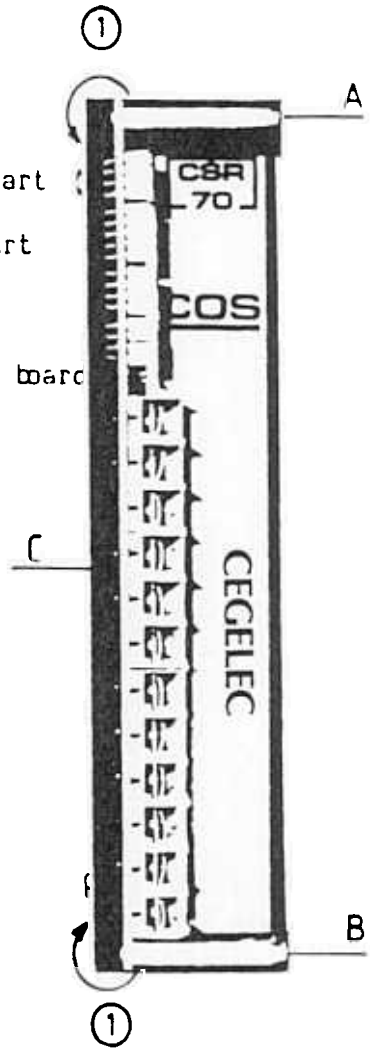


X : Moving part

Y : Fixed part

A & B : Bolt

C : Terminal board



Access to circuit

2

Overall dimensions

H = 192 mm Dept = 192 mm L = 50 mm

6 COMMISSIONING

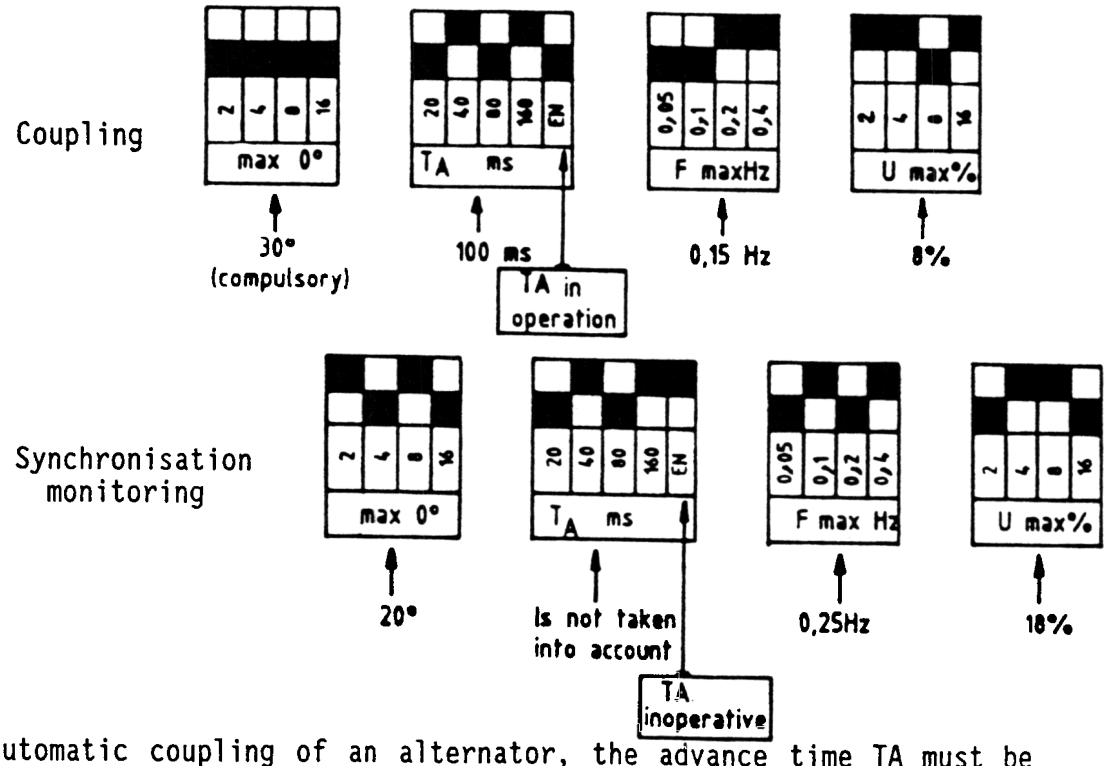
A. Before putting into operation, inhibit output order

B Check that the wiring and voltage levels are suitable for the unit i.e. 110 V or 220 V at + or - 20 %.

C Adjust parameters φ max, $\triangle$ U max, $\triangle$ F max and if applicable TA if the synchronizing ; when T_A is used set φ max to maximum 30°.

Note To adjust, use the small switches opposite each of which is a value. The set value corresponds to the total of the 4 values selected by pushing forward the cursors towards the frames where these values are inscribed.

Example



For automatic coupling of an alternator, the advance time TA must be used, by depressing the EN switch and setting φmax to 30°.

Adjust TA so that it equals the closing time of the circuit-breaker switch and the associated relays (to within approximately 20 ms).

Then adjust $\triangle$ F max and $\triangle$ U max as a function of the required synchronizing conditions.

For synchronisation monitoring, the advance time TA must be disconnected by pulling the "EN" switch.

Then adjust $\triangle$ F max, $\triangle$ U max and φ max as a function of the conditions required.

D. Energise unit and check that it is operating correctly :

the signal light φ will flash at the frequency of the input voltage beat. It will be extinguished when the phase displacement is nil.

The signal light FD will light when the two output relays are excited, i.e. when the conditions set by the unit are fulfilled.

E Close the circuit-breaker by hand having previously taken the necessary precautions.

If there is no wiring error, the coupler wil be powered by phase voltages.

The signal light φ should remain unlit.

If the unit is operating in synchronisation monitoring mode (TA disconnected), the signal light FD should be illuminated and the contact between terminals 1 and 3 closed.

If the unit is operating as a coupler (TA in), the signal light FD should be extinguished, contact between terminals 1 and 3 closed and the contact between 2 and 3 open.

F When these checks have been carried out, the coupler can be checked under operating conditions.

7 MAINTENANCE

The COS coupler requires no special maintenance.

The protection circuit may be easily tested. To make this test, short-circuit the two test points located on the front panel of the unit, then check that when the coupling conditions are effected, the signal light FD is no longer lit.

A more detailed test of the unit requires two frequency and variable voltage generators, a phasemeter, a frequencymeter, and a voltmeter.